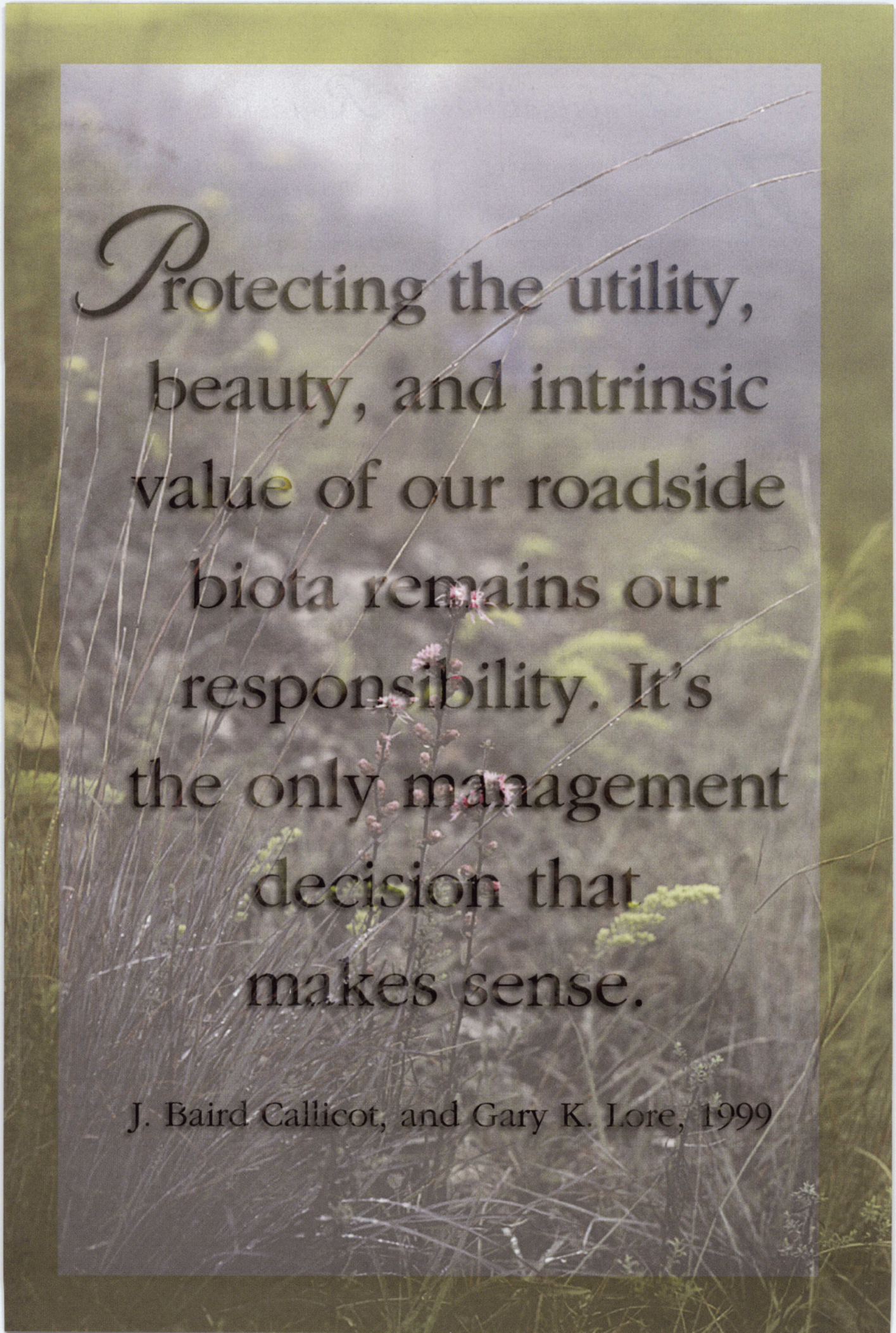
THE *Nature* OF *Roadsides*

AND THE TOOLS TO WORK WITH IT

U.S. Department of Transportation
Federal Highway Administration

Contents


Protecting the utility, beauty, and intrinsic value of our roadside biota remains our responsibility. It's the only management decision that makes sense.
J. Baird Callicot, and Gary K. Lore, 1999

Practicalities of Roadsides

Highway corridors crisscross the nation. The rights-of-way (ROW) that border the highway pavement total over 12 million acres of land neighboring parkland, farmland, natural areas, etc. ROW management affects adjacent lands. Invasive plants do not respect political boundaries or fencelines. Care for these acres is complicated by many uses: 1. recovery zone for errant vehicles, 2. utility lines, 3. snow storage/living snowfence, 4. open space, 5. wetland mitigation, 6. wildlife habitat/corridors, 7. esthetic greenways, 8.signage, and 9. refuge of biodiversity.

The roadside is a highly disturbed landscape, beginning with the highway's original construction. It continues to be disturbed with upgrades, mowing, spraying, snowplowing, grading/blading, dredging, signage, utility and fiber optic lines, and errant vehicles. How do plants react to these disturbances? Wherever bare soil results, nature's tendency is to repair itself. The first plants to occupy those bare spots are survivors that tolerate full sun, droughty and low-nutrient soils. These pioneers can be native or nonnative; depending on the soils and adjacent propagules. They are more likely to be invasive nonnatives if the soil seed bank has a history of disturbance or the adjacent land has been disturbed. Consequently, invasive nonnatives or weedy species are a continuing problem in roadside management. We have a responsibility to control and eradicate these invasive plants in the landscape. Prevention and control is also a legal obligation in 38 State Weed Laws. Respecting the plant species listed by adjacent States is being a good neighbor. Those lists warn you about aggressive plants known to exist nearby. Weeds move easily through disturbed highway corridors.

In the name of safety, improved visibility and obstacle-free roadsides, roadside vegetation managers favor grasslands. Until recently, those grasslands were commonly defined by available agricultural, nonnative grasses. Those grasses are bred to be predictable and establish easily. The establishment of regional native grasses has been studied and can also fill that practical and predictable niche in roadside vegetation. The science of native grass establishment, or revegetation, has evolved to the point where they can be planted almost as easily. Once established, the native grasses save maintenance dollars over time, provide a self-reliant and hardy plant community, improve wildlife habitat, and protect the local character and natural heritage of a site.

Because grasslands meet our practical and safety needs, local native grasslands can serve as models for roadside management. More than half of the United States was once covered naturally by grasslands: Palouse, prairies, Great Basin, meadows, glades, savannahs, balds, pine barrens, and others. In forested States, holding back the encroaching forest or natural succession results in a manageable grassland.

the Journey of Roadside Vegetation Management, A HISTORY

1930'S - THE FRONT YARD APPROACH: Roadside development was a new but natural goal following early road construction. To add to the pleasure and safety of driving, landscaping, rest areas, and so on were desirable. In his book, *Roadsides, the Front Yard of the Nation*, Jesse M. Bennett said "what is really desired, however, is attractive and useful roadsides which can be obtained by preserving or creating a natural or an approach to a natural condition in keeping with the adjacent or surrounding country. And the significant thing about this is that to follow a natural development is outright economy in road maintenance." Unfortunately it was the title of his book, not Bennett's words that became unofficial policy for many years.

1950'S - THE AGRICULTURAL APPROACH: It was logical to use available farm methods and equipment to manage weeds and appearance through mowing. With the advent of agricultural chemicals, spraying was added to mowing as a management tool. That mow-spray method continued to enhance a front yard look. The highway agencies by this time had surmised that the "look" was what the public wanted and expected.

In 1965, the transportation appropriations act added the highway beautification requirement. Motivating this requirement was the Johnson Administration's support of conserving our nation's "natural beauty". By the time the requirement was implemented into roadside use, conservation translated to landscaping, which ironically sometimes displaced our natural beauty.

1970'S - AN ECOLOGICAL APPROACH: The energy crunch of the early 70's brought a halt to this labor-intensive, fossil-fuel eating, maintenance approach. Yes, economic constraints led to ecological solutions in many States. Vegetation managers were forced to mow less and spot spray; both of which had positive consequences which included: increased wildlife habitat, enhanced natural beauty, minimized herbicide use, reduced maintenance dollars....and the public did not complain.

In 1987, thanks to the vision and influence of Mrs. Lyndon Johnson, a key amendment was added to the transportation appropriations bill by Senator Lloyd Bentson. It required that 1/4 of 1% of the landscape budget on a federally-funded project be used for the establishment of native wildflowers. Without a definition of "native wildflower" the amendment was interpreted in a range of ways from hand-planted daffodils, to naturalized garden seed mixes of oxeye, chicory, Queen Anne's lace, Dame's rocket and more. Some States seeded hand-collected local seed or commercially-grown native ecotypes. The results ranged from crowd-pleasing gardens to inexperienced and unsuccessful plantings. The public applauded and patiently watched.

1990'S - THE RISE OF IRVM (INTEGRATED ROADSIDE VEGETATION MANAGEMENT): Because safety will always be the number one priority for transportation decision-makers, most States carried on business as usual. But the fiscal constraints of the 90's tightened. Once more, States sought solutions that cost less in time and dollars. Iowa's idea of integrated roadside vegetation management (IRVM) caught on. IRVM simply meant using the most cost-effective and ecologically-sound method of management on a site by site basis. IRVM included the planting of native wildflowers and native grasses as a solution. Another method, reducing mowing, for example, also fit IRVM

and. Mowing only the first 8 feet of the roadside, plus mowing where visibility is critical was enough. Many Midwest States reduced mowing on rural highways and made the policy law. Only urban roadsides remained neatly trimmed, retaining that historical front yard look. Letters from the traveling public supported this economic/ecological approach.

2000'S - A CONSERVATION APPROACH: As we begin this century, we find that working with nature, or Bennett's 1930's ideas, are becoming the policy of the land. A combination of factors supports this approach. 1. The high cost of invasive plants is creating new private and public sector partnerships. 2. The knowledge that roadsides decisions affect adjacent lands means a need for better planning. 3. The continued need to reduce maintenance costs, makes a conservation approach economically important. 4. Our national loss of diversity, requires preservation of what we still have. Yes, a conservation approach is likely to be the accepted roadside approach by highway users and DOT management far into the future.

How the Ecological Approach Became IRVM

In the 80's Bill Haywood developed the following information in Black Hawk County, Iowa. The ecological science and common sense he brought to vegetation management fits the needs of roadsides. Here are his three ecological principles:

1. Nature does not allow bare soils to exist.
2. Bare soils are revegetated by successions of plant groups until a most-fit community of plants develops.
3. Disturbance of the vegetative cover reverses the succession of revegetation back to the bare soil starting point, and therefore allows more invasion.

Pressure to do more with less by maintenance departments everywhere led to the acceptance of such ecological principles. Key to success was preventive maintenance or avoiding impacts that disturbed plant associations in the first place. Another ecological factor was the differences among locations, including soils, aspect, moisture, context, etc. Thus it was thought that the successful solutions would be matched to each site. Deciding how to use the right tools in the right place at the right time became the goal.

Applying these ecological principles to the roadside became known as Integrated Roadside Vegetation Management (IRVM). IRVM is credited to the principles of Bill Haywood. In 1986 he said, "Success with IRVM demands a change in the philosophy guiding the management of roadside vegetation from one of weed eradication to weed prevention." This practical insight has led us to mapping vegetation, statewide planning, and new maintenance/construction practices.

Why Now?

Former First Lady, Lady Bird Johnson brought attention to highway corridors in what has been called the Highway Beautification Act of 1965. In her quest to save natural beauty, our natural heritage which she loved since a child, her influence created funding to screen junkyards and control billboards. However, she was most excited about the three cents of each dollar spent being used for acquisition and maintenance of natural areas adjacent to the highway. These "beauty spots" are our scenic overlooks, rest areas, and State entrances that underscore each State's regional beauty.

In the 1987 highway bill, her influence was once again felt. The Surface Transportation and Uniform Relocation Assistance Act included a requirement for the planting of native wildflowers. The natural beauty of her childhood was worth saving or restoring for future generations. Many restorations of native plants on roadsides have occurred. But the greatest threat to both preserved and restored sites, is the spread of non-native invasive plants. A decade later, Lady Bird watched as we began the war on weeds. Those invasive plants threatened the natural heritage she long had valued.

Today, we recognize her efforts and insights into our natural heritage. The importance of conservation is greater than ever. We can no longer talk about the preservation of native plants without considering the weeds that threaten them. Invasive plants are said to be the second biggest cause of extinction next to habitat loss. We can no longer address one problem at a time, but instead we must take a larger ecological view, recognizing that everything is connected. We cannot target one weed without analyzing the entire roadside. The endangered plant and animal survivors found there, as well as the threatened remnant plant communities must be protected. Yes, the roadside environment is connected to the entire environment and we have a responsibility to the future to sustain it to the best of our capabilities….and as the First Lady said, leave it "looking as good if not better than we found it."

Why now? We have not accomplished Lady Bird's vision for conservation of our country's natural beauty, yet. If we do not come through soon, our conservation opportunity will be buried by the spread of invasive plants.

So why not now?

Invasives 101

DEFINITION: Invasive plants are introduced species that become aggressive when moved without their natural competition to a new environment. Kudzu is an example of a plant from Asia deliberately introduced to solve land problems in the '30s. Plants native to the United States can also become aggressive when moved to another region. Black locust is such an example.

NOXIOUS WEEDS: Plants designated as noxious weeds include invasive plants that compromise agriculture, harm humans, or degrade natural areas. Most States have a unique state noxious weed list to fit their needs. There is no national noxious weed list. Only a Federal Weed Seed list exists to minimize the transfer of certain weed seed of agricultural concern.

WHAT'S THE PROBLEM? Invasive plants impact our nation environmentally as well as economically at a cost of $23 billion annually according to a recent Cornell study. Invasive plants spread into another 4600 acres daily. This is not natural evolution; rather changes ramped up by increased global mobility. These changes are caused by human decisions. We must decide to make better choices with the future in mind.

WHAT ARE THE IMPACTS OF INVASIVE PLANTS?

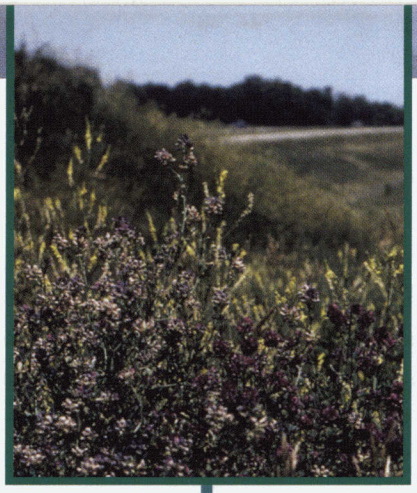
- Contaminate or outcompete crops.
- Decrease forage value of rangeland and pastures.
- Displace valuable wildlife habitat.
- Eliminate waterfowl migration stops.
- Reduce property values and ability to acquire loans.
- Alter ground water reserves
- Change the aesthetics of the landscape.
- Degrade our natural heritage and educational value
- Threaten biodiversity and research value.
- Increase fire threats
- Compromise roadside visibility and safety.
- Attract wildlife to roadside
- Add to cost of roadside maintenance.

WHAT ARE THE SOURCES OF INVASIVE PLANTS?

1. Unintentional introductions via movement of products, packing materials, etc.
2. Erosion controls include plants like: kudzu, reed canary grass, Bermuda grass, crownvetch, and birdsfoot trefoil
3. Plantings of fast-growing windbreaks and hedge rows: autumn olive, privet, honeysuckles, buckthorns, and multiflora rose have impacted natural areas.
4. Unwitting ornamental introductions.... Norway maple, Russian olive, barberries, etc.
5. Accidental movement by wildlife...garlic mustard, purple loosestrife, and most berried plants via birds.
6. Importation of topsoils to a project increases ragweeds, thistles, and sweet clovers,.
7. Ill-timed maintenance disturbances like blading, mowing, ditch dredging, baregrounding increase weeds like kochia, foxtails, thistles, and milkweeds.
8. Use of forage mulches that have not been certified weed-free increase invasives.
9. Adjacent agriculture practices increase bindweed, many thistles, leafy spurge, knapweeds, and cheatgrass.
10. Bare ground spraying increases kochia, mullein, and more.
11. Commercial wildflower seed mixes often

include invasive Dames rocket, oxeye daisy, and Queen Anne's Lace, etc.

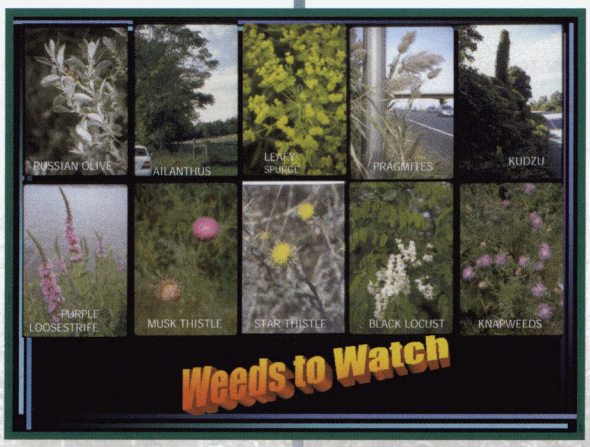
12. Erosion control mixes often include aggressive sweet clovers, alfalfa, smooth brome, trefoil, perennial rye, etc. (photo on right)
13. Movement of construction equipment from a weedy site to a non weedy site.
14. Everyday vehicle air disturbances move seeds.
15. Tourists pick weedy plants or capture seeds in pant cuffs.



WHAT CAN VEGETATION MANAGERS DO?

Note Pg. 19 for best management practices (BMPs).

TEN INVASIVES TO WATCH: Those causing huge consequences and moving quickly across the landscape include: kudzu, Canada thistle or thistles in general, knapweeds, leafy spurge, purple loosestrife, salt cedar, yellow star thistle, Russian olive/autumn olive, giant phragmites, and black locust. Other plants are climbing the charts and moving across the country: Ailanthus, common buckthorn, bush honeysuckles, pampas grass, Johnson grass, multiflora rose, garlic mustard, Siberian elm, privets, Japanese barberry, butterfly bush, crownvetch, cogongrass, reed canary grass, Japanese stilt grass, English ivy, and oriental bittersweet. Although some are unique to one region, all are capable of adapting to more regions as kudzu as proven from coast to coast.



Education for crews and the public, a UDOT poster.

EXECUTIVE ORDER 13112: Signed in February of 1999, this Executive Order aimed at invasive species, asked all agencies to cooperate and communicate in a war on weeds. A National Invasive Species Council (NISC) was formed as a result. It is a watchdog and coordinating group advised by the best weed experts in the United States. It released a national management plan to assist each State in statewide management planning. Many States are forming their own State Councils or Associations. They will serve as liaisons between the NISC and their own State issues.

The FHWA sent guidance on EO 13112 to the field in the fall of 1999. The FHWA encouraged:

1. State DOTs to inventory roadside vegetation before developing plans.
2. no DOT project will be funded by FHWA if planting known invasives on it.
3. State projects will incorporate an invasives analysis in each NEPA process
4. States join interagency partnerships as in state councils and/or MOUs
5. increased funding of maintenance efforts, research, and training

HOW TO INCORPORATE EO13112 INTO NEPA PROCESS:

What: During alignment studies, map invasive plant problems.

When: During predesign, preferably before rights-of-way have been purchased to allow for: a) not buying infested lands that will be costly to use, and b) consider an alternative.

How: Inspect project site and adjacent lands to map existing plants. Management recommendations and mapping should be part of the Environmental Impact Statement.

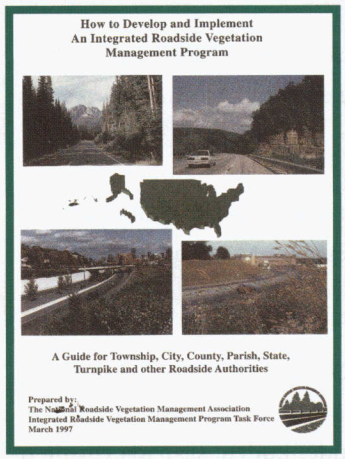
10 IRVM Tools You Can Use

1. PRESERVATION or saving the pieces should be your first choice to save time and money. What if you already have native grasses and wildflowers and just do not know where? What if you stopped mowing for one season to identify what is in the right-of-way? Your State botanists can help you determine if the vegetation is worth saving. If it is a quality remnant, you just saved a piece of natural history, more valuable than any you could plant…..and at no cost or worry. States like Delaware, Missouri, Minnesota, Wisconsin, and California have already done this. Their remnants are now signed for the traveling public and mowed less often, actually saving money.

Minnesota signs Wildflower Routes

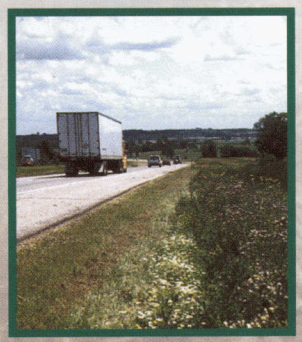
2. MAPPING is simply a way to inventory what exists on your rights-of-way. Only if you know what is there can you easily make practical management decisions. A number of States have done mapping, including West Virginia, Minnesota, Oregon, Oklahoma, Kansas, Iowa, Missouri, and Texas to some extent. Oregon signs endangered species sites, coded for maintenance crews. Minnesota signs remnants to benefit crews and the traveling public. Knowing where endangered species are located, or where native remnants need protection, or where a new weed infestation occurs will help you plan ahead. A number of mapping methods exist. Call your State Natural Heritage Program to learn what has already been done in your State

3. STATEWIDE PLANNING can be based on inventorying all vegetation, including invasives to contain, natives to protect, and endangered species. With this baseline of information, you can plan how to manage for years to come. This information will also be useful in obtaining a fair share of the budget. Some State DOTs are using Global Positioning Units to document the locations of vegetation to be considered. This information is then entered into a GIS or graphic information system that consists of a series of map overlays aimed at giving decision-makers both the details and context of any given segment of roadside. With this information, you can then decide which tool to use in vegetation control and when. Top this program with careful record keeping, and you can determine what methods are successful over time.



NRVMA's tips for planning.

4. MOWING as weed control should be well-timed. Spot mowings that target Canada thistle and other noxious weeds on the roadside are less costly than blanket mowings. Avoid mowing too short, thus scalping the plants and soils and inadvertently causing more weeds to invade. Avoid flail mowers, unless your intention is to disturb the soil for possible seeding operations. Mowing from right-of-way fence to right-of-way fence is no longer a



Wisconsin reduces mowing

common practice. Mowing just to keep the equipment occupied is not fiscally feasible. There are too many tasks stacking up for your limited crews. Reduced mowing is now possible. Mowing one or two widths off the pavement edge to provide a recovery zone for errant vehicles is important. Studies show that woody plant invasion of clear zones and backslopes takes many years before becoming hazardous to travelers. A Rutgers study suggests that crews might mow the entire ROW once every five years to prevent tree growth in forested regions, thus minimizing disturbance of the ROW and increasing small mammal and bird habitat. Less mowing also saves maintenance dollars which makes this a win-win-win idea.

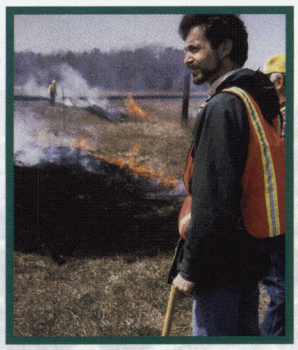
Computerized sprayers increase safety.

5. HERBICIDES continue to be an important tool in our toolbox. For some invasive plants, spraying is the only answer. Crews now have the computerized equipment and knowledge to be able to target weeds, use less product per acre, and document all conditions and location of the job. In other words, we can spray more safely with less impact to the environment and desirable plant species on the project. Be smart and careful. Annual State applicator trainings continue to educate crews in best practices.

6. BIOCONTROLS already exist for purple loosestrife, leafy spurge, knapweed, and musk thistle. Kudzu could be next. The United States Department of Agriculture has spent time and money in introducing safe biocontrols for some of our toughest noxious weeds. In Tennessee, the DOT was able to reduce musk thistle infestations by 95% with one

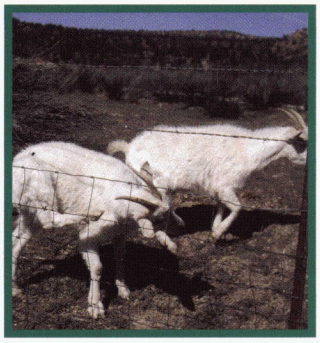
School kids celebrate the release of purple loosestrife beetles.

such biocontrol beetle. Biocontrols are a relatively inexpensive and safe alternative to blanket spraying of large populations of invasive species. Because most invasive plants outcompete desirable plants and appear to have left their natural competition behind in their country of origin, finding and applying these biocontrols is logical and useful. This tool can also be a great public awareness event to help your public understand the work you do.



Training is everything.

7. PRESCRIBED BURNS have been used by land managers for over 25 years in modern history. The value of a well-timed and placed burn of native vegetation has been apparent for many generations in this country alone. The procedure is practically explained by Wayne Pauley in his *How to Manage Small Prairie Fires,* 1988. However, never attempt a roadside burn without training from an agency that has a history of this vegetation management method. Even when site conditions appear to be perfect, winds can shift and throw the procedure into chaos. After learning how to burn, and acquiring the appropriate equipment, safety plans must be done. How will traffic be advised? How will cars move through the burn? What and how will you tell the public? A water truck and local firefighters should always be on alert for the event. A safe burn is the only acceptable burn, or this tool will be lost.



Goats appear to be an inexpensive and effective tool for knapweed on an inaccessible watershed slope in Oregon.

8. GRAZING GOATS can safely be used for vegetation management! A number of States including New Mexico, Oregon, and Montana have discovered the cost-effectiveness and success of this tool. Herds of goats can be fenced or trained to stay within the roadside as they munch their way through vegetation including invasives. Remember sheep were once the tool used to "mow" the White House lawn. Much remains to be learned.

Iowa DOT plants a diversity of grasses and flowers like these.

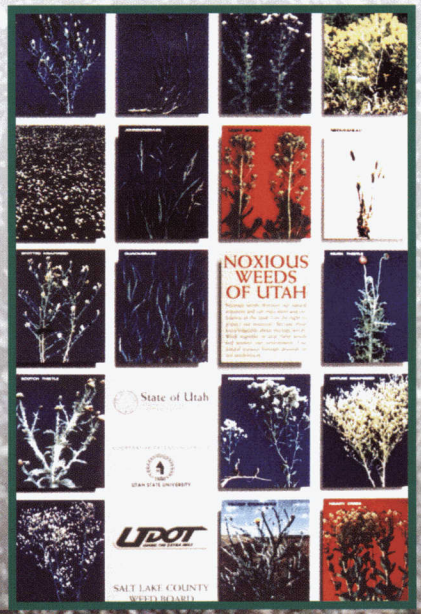
9. NATIVE PLANTINGS that are well-established and undisturbed are an excellent defense against nonnative plant invasions. Because native plantings have erosion control value, wildlife value, low maintenance, biodiversity, and natural heritage benefits, native plantings are another tool in the toolbox.

Native plant restorations began in the United States some sixty years ago. Some of these have been studied for decades. Here are a few insights learned from the Curtis Prairie in Wisconsin:

1. If weeds are not eliminated before planting, they will persist for decades.
2. The number of species planted defines the diversity of the site long into the future, unless the project is adjacent to a natural area, from which native propagules can travel.
3. On projects with varied microclimates, a number of mixes might be necessary. A buckshot seeding, of one mix fits all, is likely to fail because xeric species cannot move if they die in a wet spot, etc. Some species are generalists, but not many.
4. Local seed, seedlings, or sods are more successful than seed from far away locations.

10. INFORMATION SHARING includes activities such as:

a. Visit the Utah Dot Vegetation Management Academy for a good training example.
b. Develop plant identification tools like Maryland's field guides and Utah's posters.
c. Wisconsin holds an annual workshop to educate consultants and contractors.
d. Attend other land managers' training sessions.
e. Network with counterparts in other agencies.
f. Become a member of NAWMA, NRVMA, IECA, and/or SER.
g. Expand annual herbicide training to include all tools with hands-on demonstrations.
h. Use conservation group information (Pheasants Forever, Ducks Unlimited, The Nature Conservancy, Natural Areas Association, Native Plant Societies, EPPCs, and Garden Clubs).
i. Take advantage of university research and offer research sites on highway row.
j. Learn from successes in other states, avoid wasting time/$$$ by convening at the border.
k. Check out vegetation websites.
l. Improve public awareness through media, volunteer projects, and public meetings.



Education for crews and the public, a UDOT poster.

Preservation is the First Choice

Preservation of quality natural remnants and habitats has become routine in new projects that threaten wetlands. But law does not require we preserve woodlands or grasslands. Consequently, these ecosystems are diminished time and time again by developments of many kinds. Why should we care? There are many reasons.

Protecting quality remnants protects individual plants that could:

- serve as sources of new medicinal remedies,
- provide recreation as in photography, etc.,
- be key to applied scientific study,
- act as indicators of environmental health,
- enhance diminishing wildlife habitat,
- uplift the human spirit,
- preserve local natural heritage,
- add to the aesthetic beauty of the place,
- reflect regional identity,
- and survive as connections to the greater community of life.

For roadside managers, protecting quality remnants has more than environmental benefits. Economical benefits include:

- no cost to plant natives where they already exist,
- maintenance cost is less than mowed turfs,
- public support leads to legislative support,
- undisturbed native plantings have fewer weed problems, and
- increased value to their own community's quality of life.

Considering these environmental and economic benefits, we should follow the lead of States like Delaware, Minnesota, Missouri, California, and others who already protect remnants. Check the Best Management Practices section to learn more.

A species must be saved in many places if it is to be saved at all.

Aldo Leopold, Sand County Almanac, 1949

How to Work With Native Plants

AN ECOLOGICAL APPROACH TO NATIVE GRASSLAND VEGETATION

An often misunderstood management tool, restoration of native vegetation is likely to have a simplistic yet cost-effective interpretation on highway rights-of-way. Because the engineered roadsides, including slopes and holding ponds do not resemble the original soil profiles before construction; restoring, in the true sense of the word, is impossible. Yet we can aim for a simplified and functional version of what was there before disturbance. We can attain a semblance of an appropriate native plant community that fits the existing site and our need for safety. In most cases, the need for safety will limit us to an herbaceous seed mix of native grasses and wildflowers. Some basic steps are common in this process throughout the nation.

STEP 1 – SITE ANALYSIS

a. Environment: Determine existing soil type, available moisture, slope aspect and angle. When specifying a seed and/or seedling list, match grasses and flowers to site conditions thoughtfully. Obviously the original soils are gone and the matching will be difficult.

b. Invasive plants: Especially note existing weeds on and off site that will compete with a new planting, and plan accordingly.

c. Context: Actvities on the other side of the ROW fence can affect your project. If the project is in a rural environment, note vegetation management on adjoining fields. If not controlled, those species can out compete your planting. Within the City Limits, note City parks, natural areas, and golf courses. A more natural design and materials will fit there. But within the formal developed city space, a formal design is appropriate to compliment our neighbors. Some horticultural plants, although traditionally used in these locations, have become invasive outside the city limits. Plants like Norway maple, Russian olive, and Tatarian honeysuckle are well-adapted disturbance plants and should be used as a last resort within the City, and never outside the City Limits.

STEP 2 – PLANT SPECIES LIST

a. Refer to your State's map: First check your State's natural region map** to determine which plant communities are commonly adapted to your site.

b. Locate a comparable natural site: Visit the preserve. Find an inventory list of native grasses and forbs to be used as groundcover (such a list should be obtained from your Natural Heritage Program for that preserve). Observe the natural associations for clues.

c. Narrow a shopping list: Single out those that match the dry, mesic, or wet microclimates of the project site. More than one mix might be necessary. With plant species list in hand, check early for commercial availability. Aim for as much diversity as the project can afford. Every State has native grasses and forbs that will tolerate harsh roadside environments.

d. Remember native grasses: The result of planting native flowers only, is messy at best. Without their natural relationship with native grasses, the forbs compete with one another. The native grasses add fine texture, fall color, and a backdrop to show off the native wildflowers.

e. Write the specification as tightly as possible to get the result you want. Hold annual consultant and constractor workshops to familiarize bidders with your new methods.

STEP 3 - SITE PREPARATION****

a. Minimize disturbance: Disturb the site as little as possible after controlling invasive plants. Remember those invasives have likely added their seed to the soil seed bank. Any tillage will stir them to germinate. A simple method would be 1. mow and rake off dead vegetation, and 2. scruff soil with rake, harrow, but nothing deeper than 1/2 inch. Then plant.

b. Berm project topsoils: Project site soils will have been highly disturbed in the end. However, salvaging topsoils on site can be planned. Winnowing those soils along the edge of the project can be beneficial. These soil berms can prevent runoff better than silt fencing. Then these berms can be spread over the rights-of-way before seeding. This is less costly than importing soils later; especially when the seed bank of imported soils is unknown. Topping a project with weed-laden soils will not yield a success story.

c. Eradicate invasives: It has been proven that weeds that exist before a planting, will continue to plague the planting in the future. Before the bulldozers begin staging, control any noxious weeds found on the project. This small cost of time and effort will prevent the spread of weeds to other projects via construction equipment, as well as save money in roadside management later.

d. Prepare the planting bed: in the least disturbing way. This means minimal tillage, or shallow tillage at a maximum. Specialized seed drills , broadcasters and/or hydroseeders cause minimal disturbance.

STEP 4 - INSTALLATION BASICS

a. Research Seeding Rates: Native seed mixes are typically planted at the rate of 10-20 pounds per acre, usually the lower number. Seeding more will not insure success, but waste valuable seed instead.

b. Decide Seeding Method: Drill native grasses when possible to get appropriate seed-soil contact. By broadcasting forb seed over the top, seeded rows will not be so apparent. The broadcasted seed should be raked, rolled, and/or mulched in. (In some regions, or 1:1 slopes, hydromulching is preferred.) Water only if seasonal rains do not occur. Fertilization or compost only encourage weeds.

c. Accept variable Timing: Many projects do not allow us traditional optimum seeding times. The agricultural approach of spring and fall seedings has been blamed for many failures. Current observations find that most native seedings are successful when planted spring, summer, or fall. Apparently, the native seeds are adapted to germination when conditions match their needs.

STEP 5 - FOLLOW-UP

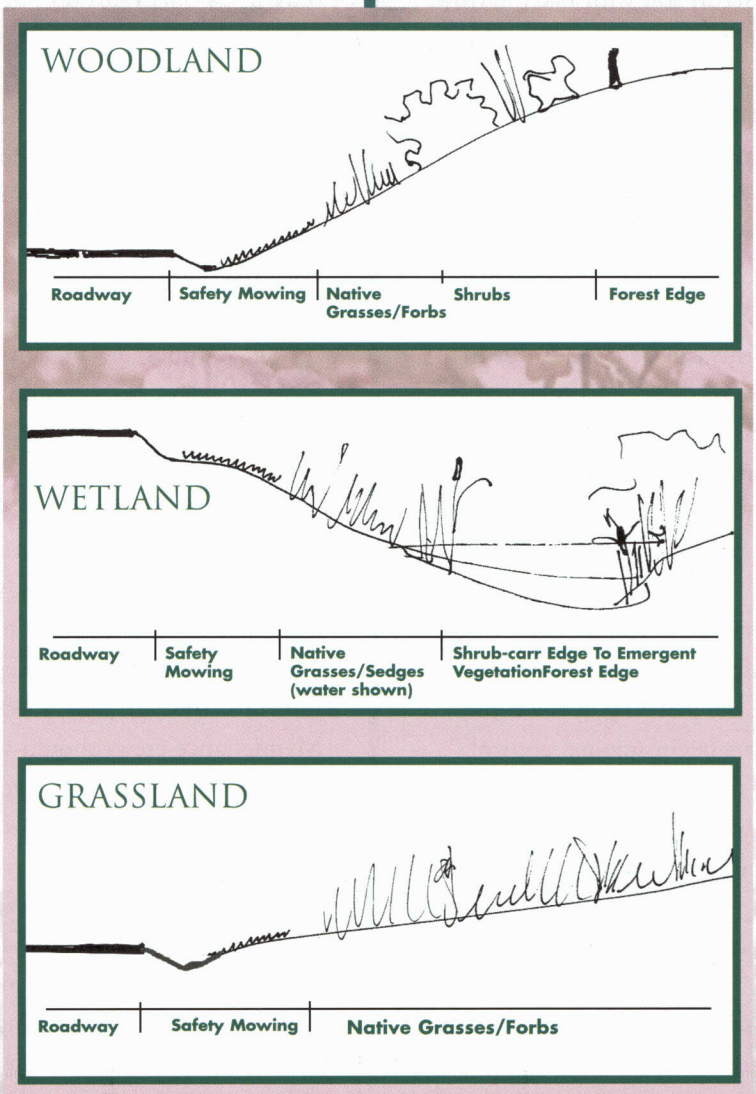
6 to 8 weeks after germination, mow, where possible, at a height of 6-8 inches to discourage shade of early weeds. Only spot spray invasive plants that emerge. Keep the public informed through local media and/or signage. Maintenance crews should understand the project so as to avoid inadvertent mowing. Better yet, invite their input during project planning. If local volunteers are included in the project, let them help with public relations. With an informed public, no one should be questioned about their maintenance work. And no unnecessary mowings should occur...only the safety strip along the pavement for which you have planned. Don't forget to add this planting site to your GIS system for future tracking and management. Finally, succession or change over time, will occur. Plan for it!

Planting on the Edge,

TYPICAL ROADSIDE SCENARIOS:

Highway corridors are often on the edge of woodlands, wetlands, or grasslands. Or they have created an edge to these plant communities. We can protect those natural areas and meet roadside safety needs by planting a transition zone. Since grasslands are early successional stages to each, maintaining native grasslands as transitions is a natural.

Below are sketches of a woodland, wetland, and grassland concept adjacent to the roadway with a grassland transition included. These grasslands pull duty as erosion control, revegetation and/or landscaping while allowing a safe recovery zone. Contact your State's Natural Heritage Program (experienced in local plant communities) or The Nature Conservancy (experienced in land management) to learn more about grasslands in your area.



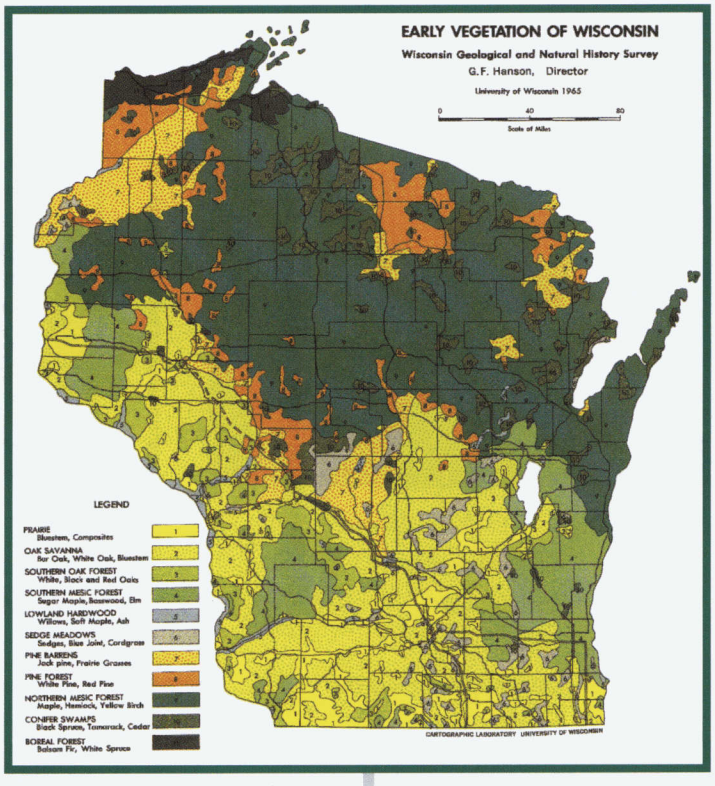
WOODLAND EDGE – Here an herbaceous native seed mix can cover the entire site. This allows shrub and small tree seedlings to be planted or to migrate from the adjacent woods. Mowing once very 2-5 years will discourage encroachment by woodies into the clear zone.

WETLAND/ DITCH/HOLDING POND EDGES - A native grassland seed mix can cover all. However, a wet and wetter seed mixes with sedges might be used to border the existing wetland dependent on moisture availability. A shrub-car mix of shrubs and grasses could be added for esthetic and/or wildlife benefit.

GRASSLAND/ OPEN SPACE/ MOWED EDGES - Whether next to a meadow, pasture, or cropland, a native grass seed mix works as a transition here. You need a mix that will tolerate poor soils and full sun, similar to the conditions of a southern glade, shortgrass prairie, alpine meadow or desert grassland.

State Natural Vegetation Maps

**STATE NATURAL VEGETATION MAPS serve as references for native plantings. This maps are often based on original surveyor notes at the time of European settlement.



Granted, a lot of development and disturbance have followed. However, using a reference that suggests the kinds of plant associations that tolerate the weather patterns and geology of your project is just another ecological insight into chosing hardy plant materials. When designing with native plants, cold hardiness zones are meaningless. Natural region maps are commonly available from your State's Natural Heritage Program. They can also suggest preserves you can visit that serve as references for your planting. Let the natural environment give you some insights about what grows where and with what other species. Every State is different. Delaware has two natural regions, California has twenty-two, and Wisconsin has eleven, per the Kuchler description of native plant communities. New descriptions are being developed.

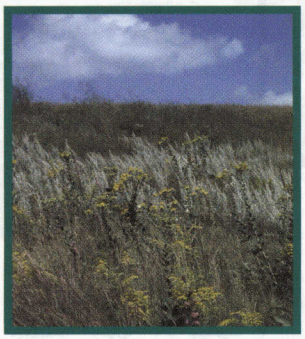
Sample Seed Mixes

Sample seed mixes for a hypothetical Wisconsin right-of-way, an overlook, in West Central Wisconsin lies in what once was oak savanna with grassland understory. A small prairie remnant is near the site. The inventory list for the preserved prairie is available from the Natural Heritage Program. Three site-specific seed mixes will be needed: a. dry conditions on the sandy slope or forest edge to the right, b. mesic conditions around the overlook parking lot which is partially mowed, and c. wet conditions in the ditch between the slope and pavement edge.....all zones in need of a grassy solution for safety and stabilization.

Basic to a successful seed mix is knowing the plant species (or accessing someone who does) and species' range of tolerances. One seed mix cannot possibly fit all occasions. Site-specific solutions are encouraged. In this case, for example, Canada Wild Rye would tolerate all three microclimates and serve as a cool-season or immediate cover crop. Little bluestem would survive the dry and the mesic sites but not the wet ditch. And so on. Without that kind of site-matching, our use of native species will be unsuccessful. Site-matching is key to

successful establishment. Although the species list in each mix should be as diverse as possible, availability and cost can shorten the shopping list quickly. Aim for a minimum of 10-15 in the beginning.

Ultimately aim for Iowa model mixes of over 100 plant species! Here are sample mixes that should thrive on our pretend project. Although these species are relatively common and available, obtain them from growers close to the project when available.



A. DRY SEED MIX(SLOPE)

little bluestem
side oats grama
Canada wildrye
prairie phlox
blazing star
prairie coreopsis
smooth aster
birdsfoot violet
leadplant
stiff goldenrod

B. MESIC SEED MIX (LOT)

little bluestem
Indiangrass
Canada wildrye
purple prairie clover
blazing star
yellow coneflower
heath aster
spiderwort
bergamot
showy goldenrod

C. WET SEED MIX (DITCH)

Indiangrass
switchgrass
Canada wildrye
mountain mint
gayfeather
common oxeye
New England aster
blue vervain
Joepyeweed
golden Alexander

****NATIVE SEEDING SPECIFICATION TIPS:**

1. Eradicate weeds from planting site before planting.
2. Consider a line item for contractor to control weeds and clean equipment.
3. Plant as much diversity as possible, unless an adjacent native seed source exists.
4. Match site microclimates with distinct seed mixes as much as practical.
5. Most native species will establish more easily, if you specify a locally-grown or collected source.
6. Order native seed when the contract is let to prevent unwanted substitutions.
7. Limit bids to experienced contractors and approved vendors for these projects.
8. Separate the planting contract from the general contract for best timing.
9. Extend the establishment period to three years and include patience.
10. Learn appropriate seed test criteria and seeding rates to avoid waste.

NOTE: The native wildflower mixes contain both native grasses and native flowers/forbs. They naturally grow together. Each mix has a variety of seasonal colors and textures to please the traveling public. The mixtures are all perennial and will return for repeat performances. While the cover crop performs erosion control, the other plants will slowly establish. Patience might be specified here. A minimum of three years is needed to approach the visual goal of the project.

Succession Saves Time & Money

Let's examine what this word means to roadside environments. Succession is the process of vegetation change overtime. It begins with bare soil and what plants are able to occupy that space first. Before settlement, bare soils were caused by wind, flood, fire, and other natural disturbances. Over time most soils reach a vegetated state that is stable, predictable, and practical for roadside management.

Then came road-building, important to our development as a nation. When we constructed roads, we opened up soils to a new cycle of succession. The first seeds to pioneer into these disturbed soils came from the seed bank of the soils themselves, as well as adjacent lands which had not been greatly disturbed. Thus the first plants into a construction site were native to the area. As a result, some of our oldest roads, now are refuges for remnants of regional plant communities, even endangered species.

Centuries later, we can no longer disturb soils and expect native plants to fill the open niches. Due to human disturbances and inadvertant plant introductions, more competitive and invasive plants are poised to occupy bare soils - the bare soils vegation managers open up through blading, mowing, spraying, and other maintenance activities. Yes, our own actions often unintentionally encourage the spread of invasive plants or weeds. Because we can often predict those consequences, we bare responsibility to make maintenance and management decisions carefully.

The good news is that we can actually work with natural succession to minimize maintenance costs, and reduce management efforts! Inventorying what vegetation exists and where, can help predict what problems and opportunities will arise. We can plan accordingly and estimate budgets more accurately. For example: if we are doing a pavement shoulder addition in the Piedmont of Georgia, our inventory will tell us that the existence and threat of kudzu is great on the project. We will save time and effort if we eradicate the plant long before the project begins; seed native grasses and forbs characteristic of the region into the site after construction, and plan to monitor and spot spray for some years after the project.

On the other hand, if native remnants are about to be disturbed by the project, seed collection and plant selvage could be part of the answer. Bottom line, we should pursue maintenance methods that disturb the soils as little as possible, or be prepared for the predictable weeds. Aiming at stable plant associations along the roadside that are consistent with our safety goals is an objective that will reduce crew effort and cost over time. In other words, managing roadsides for early-successional grasslands avoids costly brushing, hazard tree removal, and crashes. Use of grasslands is ecologically safe, economically smart, and safety wise!

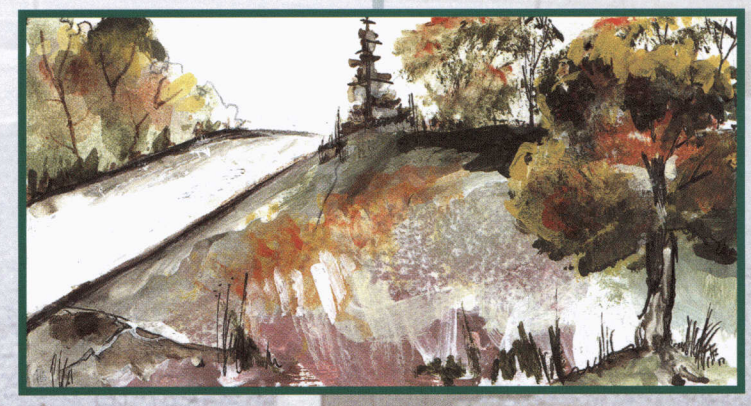
Succession in Forested Areas

In forested regions, where forests are the stable plant community, we can predict the time it takes for vegetation to cover bare soils and reach a forested state. Based on this scientific insight, we might be able to reduce our roadside mowing in rural areas to no more than once every five years. Basic safety mowing only would greatly reduce the annual budget cost!

Three sketches demonstrate succession in New Jersey that was monitored for 50 years to learn how an open field in the Eastern deciduous forest changes over time, much in the way an herbaceous right-of-way will change if left unmowed. The study implies that mowing once every 4-5 years would be enough to discourage forest invasion into the roadside recovery zone. (Robichaud Collins and Anderson, 1994).

Year 3 after old field equivalent of roadside has not been mowed. Mostly perennial herbs like goldenrod and fleabane are found.

Year 6 without mowing allows some invasion by red cedar, sumac and Queen Anne's lace.

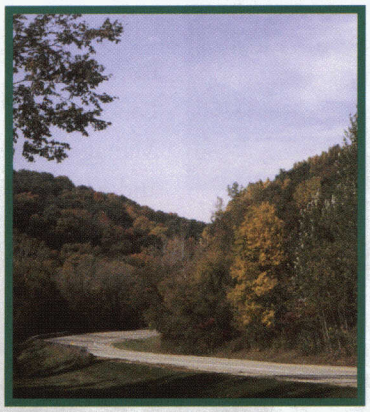


Year 12 without mowing results in abundant red cedar and woodland edge shrub and tree seedlings.

10 Best Management Practices That Work

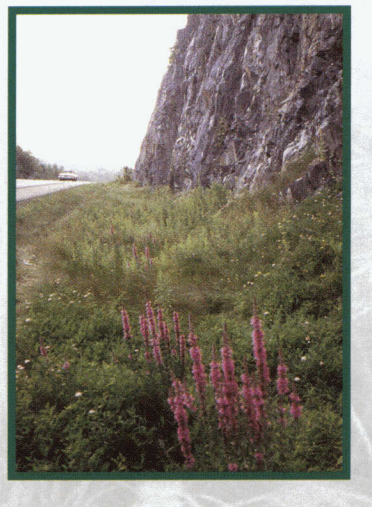
1. UTAH INCORPORATES INVASIVE POLICY - In 2000, the UDOT Quality Improvement Team was formed to dtermine appropriate strategies to implement the 1999 EO 13112. The team included folks from maintenance, construction, design, and environmental divisions. Potential invasives impacts are now included in environmental documentation. Also included are Best Management Practices (BMPs) to deal with invasives. Early analysis, Special Provisions, equipment cleaning, and revegetation of bare soils are some of those practices.

2. WISCONSIN WRITES A WILDFLOWER WAIVER - Instead of trying to find a loophole to plant less native plants, the Wisconsin DOT found a way to plant more. Working with their FHWA Division office, they combined the 1987 STURAA with common sense to increase the use and preservation of native plants. They created a waiver agreement which allows them to avoid planting native wildflowers where they are not appropriate, but bank the unused dollars for larger projects in the future. They also agreed to bank any preserved plant communities that are possible during the highway design process.



3. WYOMING DEVELOPS WEED-FREE MULCH REQUIREMENT – Concerned about the increase of weed pests in the West, WDOT worked with other State agencies to develop legislation requiring weed-free forage or mulches on highway projects. Many neighboring State DOTs have joined forces to stop this mode of spread in a dramatic way. They are now part of the effort through the North American Weed Management Association (NAWMA) to develop standards that can be used nationally.

4. VERMONT PURSUES PURPLE LOOSESTRIFE - Recently, the Vermont Agency of Transportation (AOT) partnered with the Agency of Natural Resources (ANR). Using ANR's statewide mappings of purple loosestrife, the AOT has set up research sites to learn which purple loosestrife control methods are most successful in New England over time.



5. NEW MEXICO JOINS OTHERS IN THE WAR ON WEEDS – In 2001 The DOT and 32 groups signed an MOU that set up Coordinated Weed Management Areas (CWMAs) throughout New Mexico. The partners agree to inventory, manage, prevent, and eradicate whenever possible, plants designated

as noxious pursuant to New Mexico weed law. The partnership includes military lands, tribal Councils and State agencies.

6. FLORIDA REQUIRES CERTIFIED WEED-FREE SODS - Because of good growing conditions and international connections, Florida has been overrun by alien plant species. The FDOT continues to seek ways to stop their spread and protect their natural environment. The FDOT has worked with the State Department of Agriculture to craft a certification program that rewards the propagation of weed-free sods. Florida now requires weed-free sods in its construction, landscape, and erosion-control projects.

7. WISCONSIN REDUCES MOWING - The Wisconsin DOT adopted a Natural Roadsides philosophy in the 1950's when it became apparent that it would be fiscally impractical to mow the entire highway rights-of-way on the new 4-land divided highways that were being built. A limited mowing policy was written. That policy, with some modifications, is still in place today. The policy allows much of the natural vegetation to regenerate naturally. Generally the vegetation is mowed to a minimum height of six inches for fifteen feet on outside shoulders and five feet on median shoulders. As a result a recovery zone is assured, costs are reduced, and Wisconsin's natural beauty is preserved. (Michigan and Minnesota also have reduced mowing laws.)

8. CALTRANS – PROTECTS NATIVE PLANT COMMUNITY REMNANTS -
The California Department of Transportation began a plant community preservation program in 1994. Working with conservation groups, they identified more than 20 quality remnants on highway ROW. These valuable pieces of natural heritage are called Biological Management Areas. Each is signed and has its own management plan. Ironically roadsides are

sometimes the last refuge of unique plant communities and/or plant species.

9. OREGON PARTNERS WITH ITS NEIGHBORS
In a creative effort to control weed invasions, the Oregon DOT is part of an unusual partnership, crossing many political boundaries, just like those pesky plants. Together with the Bureau of Land Management and Malheur County, the DOT shares equipment and personnel to spot spray weeds on all agency lands, and adjacent landowners on request. This on-the-ground weed control team is a practical answer to dwindling resources on all levels.

10. VIRGINIA RESTORES RARE PLANTS -
VDOT has reintroduced native yellow pitcher plants (*Sarracenia flava L.*) at a time when only 100 plants are known to occur in the wild in that State. VDOT partnered with the Meadowview Biological Research Station of Woodford, Virginia to propagate these plants from seed and then plant on a wet site along the interstate. Other rare wetland plants complete the association. Being good stewards of the Commonwelth's property, VDOT is striving to make a difference both aesthetically and ecologically on their roadsides.

10 Applicable Research Reviews:

1. CALTRANS FINDS SUCCESS FIGHTING INVASIVE WEEDS WITH FIRE

Five acres of highway ROW were targeted to learn more about prescribed burns as a management tool in California. The Bear Creek Botanical Management Area contains a plant community remnant with more than 100 native California plant species. It is one of the last examples of Upland Wildflower Fields in California. After careful planning, the District 3 forces coordinated the safe passage of vehicles. The California Department of Forestry and Fire Protection (CDF) conducted the burn. The key target was yellow star thistle which had invaded half the site within a short time. Observations following the fire have shown the prescribed burn to be more effective than the preceding years of mowing, spot spraying, and hand pulling of star thistle. Remember only trained burn crews abiding strict burn protocol should be used in highway corridors.

2. FLORIDA DOT SUPPORTS COMMERCIALIZATION OF LOCAL ECOTYPES.

The University of Florida has worked with the Brooksville Plant Material Center to collect and propagate a Black-eyed Susan commonly used by the Florida DOT. Roadside testing of the Florida ecotype began in 1999 and seed has been made available to commercial growers. Much of the original collected seed was growing under a canopy of slash, loblolly, or longleaf pine that had been subjected to periodic prescribed burns. This kind of success is key to the Florida DOT who set the deadline of 1998 to start using florida-grown seed of native wildflowers. Before this time, no commercial sources of Florida ecotypes existed to supply their needs.

(For more information: Florida **Black-eyed Susan** Ecotype, Dr. Jeff Norcini at (850) 342-0988, University of Florida, 2002)

3. IOWA ROADSIDE RESTORATION BENEFITS BUTTERFLY POPULATIONS

Restoration of roadsides to native habitat has been suggested to benefit wildlife in two ways: by adding habitat and restoring connectivity between fragmented reserves. In Iowa, which has one of the highest road densities in the United States, roadside vegetation has traditionally been managed to maintain a monoculture of exotic grass. Recently, many counties have begun integrated roadside vegetation management which both restores native vegetation and reduces the use of herbicides and mowing. This study evaluated the effect of this management regime along central Iowa roadsides. 12 separate roadside areas were surveyed for abundance and species richness of disturbance-tolerant and habitat-sensitive butterflies and compared with nearby roadside dominated by primarily nonnative legumes and /or grasses.

Species richness of habitat-sensitive butterflies showed a two-fold increase on restored roadsides compared with grassy and weedy roadsides. Abundance increased five-fold for native grass and forb habitat over nonnative. Tracking studies found butterflies were less likely to exit the restored roadsides, indicating mortality rates may be lower and offering preliminary evidence that roadsides have the potential to be used as corridors.

(For the entire report, contact Leslie.Ries@NAU.EDU or (520) 523-7839.)

4. WETLAND DISTURBANCE INCREASES THE SPREAD OF INVASIVE PLANTS.

The spread of invasives like purple loosestrife (Lythrum salicaria), cattail (Typha x glauca), reed canary grass (Phalaris arundinacea), and phragmites (P. australis) has dramatically changed wetland vegetation in temperate North America. Three theories have been

advanced: a. Growth is more favorable to the newcomer in new environmental conditions, b. Introduced plants have left their herbivore competition behind, and c. Interspecific hybridization of the new plant and one existing in an area results in a phenotype with advantages to conditions not favorable for either parent. A literature review was done to find support for these theories.

Studies revealed:

a. Few studies compare competition between growth in new range versus historic range.
b. Little evidence is found to support the herbivory idea; but hydrologic alterations could facilitate invasions by cattail and reed canary grass and increased salinity facilitates phragmites.
c. Hybridization is a cause of spread in purple loosestrife and cattail.

For more information, contact Susan M. Galatowitsch, University of Minnesota at 651-645-1715.

5. EROSION CONTROL AND ENGINEERING PROPERTIES OF NATIVE VEGETATION.....

is an ongoing study by the Texas Transportation Institute. Native grasses and prairie plant associations are well adapted to the harsh open environments shared by many highway roadsides. Because Texas uses Bermudagrass, native and nonnative wildflower mixes, native grass, and crownvetch each were planted and compared. Because the project has only two years' results to report, no conclusions are drawn. Initially Bermudagrass outperformed the other plots. Eroding rain events are planned.

However, the study is continuing and will teach us more. Contact Harlow Landphair for more information at 979-845-1734.

6. CREATED WETLAND DOES NOT MEASURE UP TO RESTORED WETLAND

An eight year study of wetland restoration and creation in Wisconsin mitigation efforts underscored the fact that the best solution remains the avoidance of wetland impacts. In addition the USGS research concluded:

a. the cost of the restored site was 1/15 the cost of the created wetland. The cost of earth-moving is the deal-breaker.
b. Implementation of the restoration was much shorter (two weeks) than wetland creation (six months). And 3) a 1993 wetland delineation compared the sites to find that 60% of the created site passed as wetland while 100% of the restored site was determined to be wetland. Rehabilitating a drained wetland was cheaper, faster, and more successful than creating an artificial wetland. For more information: Randall Hunt, USGS at 608-821-3847.

7. NATIVE/NONNATIVE COST COMPARISON

a. Meanwhile, Australia is pushing to preserve native remnants as theirs disappear through continued land-clearing. Building the case includes a benefit cost analysis of remnant vegetation on private property.. Two benefit components underlie the results – a private benefit to the condition and productivity of landholders' properties, and a public benefit associated with biodiversity conservation and aesthetic values. Conservation incentives would be involved. Perceived benefits not documented in this study include: remnant vegetation species control of agricultural pests, riparian vegetation protecting fish stocks, and remnants increasing productivity of properties downstream.

(This ongoing study, Report No. 130 by Michael Lockwood –mlockwood@csu.edu.au)

b. Iowa, a State that lost all its native grasslands during settlement, began a cost analysis of roadside vegetation to compare the costs of using native and non-native species on Iowa roadsides over time. The study will be repeated a couple times to get a fair comparison. Although the results are not yet reported, IDOT continues to increase its native plantings, convinced of the benefits to be proven. (For updates, contact Mark Masteller at 515-239-1424 on Roadside Vegetation Maintenance on Iowa's State and County Roadsides: A Cost Analysis begun in 1995.)

8. ROADVEG IS A ROADSIDE-SPECIFIC GIS TOOL

Developed by the Utah DOT out of necessity, ROADVEG provides roadside specific tool. Call Ira Bickford for your copy at 801-965-4119.

9. ANALYSIS OF CONSTRUCTION SOILS NOW POSSIBLE

A practical, cost-effective tool has been developed by Chris Allen of Brigham Young University and will be available soon..

10 NATIVE GRASSLAND PLANTINGS EVALUATED IN THREE STATE STUDIES:

a. Texas –Aimed at the best methods to establish and use native grass communities on roadsides, TTI research developed guidelines to aid managers in selecting appropriate management techniques. (Prairie Restoration: An Evaluation of Techniques for Management of Native Grass Communities in Highway roadsides in Texas, Research Report 944-1, TTI, James R. Schuttt and Michael A. Teal, 1994.)

b. Florida – The Florida DOT, University of Florida and The Nature Conservancy explored site preparation, seeding methods, and management treatments in the establishment of native plants on Sandhill roadsides. Conclusions include: 1. Mowing outside the clear zone need not happen more than once every three years; 2. Over the short term, a prescribed burn is not a substitute for mowing woody species, 3. Little bluestem may form a continuous turf, 4. comparison of many planting devices found the hayblower to be the easiest and most efficient, and 5. native cover, resembling natural areas, can be re-established on sandhill soils within 3 years of sowing.

(Native Sandhill Species Revegetation Techniques, The Nature Conservancy-Florida, Doria R. Gordon, 2001)

c. South Carolina – The South Carolina DOT and Clemson University analyzed the I-26 corridor that transects all the soil regions of the State. Generally their roadsides are infertile. Most sites sampled would not be suitable for pasture sods. Although the dominant roadside vegetation is planted to bahiagrass, native plants are found on rights-of-way that are less frequently mowed. The South Carolina natives tolerate infertile soils and are recommended for roadside use. (Establishment and Management of Native Grasses and Forbs in Highway Corridors, William C. Stringer, Clemson University, 2001.)

Useful Policies

NATIVE WILDFLOWER REQUIREMENT

The STURAA or Surface Transportation and Uniform Relocation Assistance Act became effective in April of 1987. It contains a mandatory requirement that native wildflower seeds or seedlings or both be planted as part of landscaping projects undertaken on the Federal-aid highway system. At least one-quarter of one percent of the funds expended for a landscaping project must be used to plant native wildflowers on that project. Although waivers were granted in the beginning where growing wildflowers was difficult; the science and industry of native wildflower planting has grown to the point where waivers are no longer encouraged. (An example of an acceptable waiver is shown on page 19.) Native wildflowers are forbs and grasses that existed in a region before European settlement.

USE OF NATIVE PLANTS

The Executive Memorandum on beneficial landscaping became effective in April of 1994. This Executive memorandum encouraged the use of native plants as much as practicable on all federal lands and in all federally-funded projects. The Native Plant Initiative, an interagency coalition, has worked together to share information and resources to improve public awareness, educate their own forces, increase planting success, and more. Their Plant Conservation Alliance website is www.pca.org. In 2000, this EM was incorporated into EO 13486, the greening of government. Thus what was once a suggestion, is now law. A copy of the EM can be found on the FHWA website.

PREVENTION OF INVASIVE SPECIES

The Executive Order on invasive species (EO13112) became effective in February of 1999. This Executive Order encourages cooperation and communication at all levels of government to prevent and control invasive species. The EO asks that native plants be restored to newly controlled sites. The EO also set up a National Invasive Species Council (NISC), on which all interests are represented. An Advisory Committee of national experts supports the council, whose first mission was to define a national management plan within 18 months of the signing by President Clinton. State Invasive Species Councils are being set up around the Country to reflect the cooperation of public and private sectors in each State. The FHWA Guidance for implementation was released in August of 1999 and can be found on our website www.fhwa.dot.gov/roadsides.

INVASIVE PLANTS AND THE NEPA PROCESS

EO13112 guidance from the FHWA was expanded to include the NEPA process. All EIS reports should include an analysis of the invasive plant presence on a project site and prediction with recommendations of new invasives resulting from soil disturbance during the project. An invasive plant management plan should be designed on a site specific basis.

20th Century Roadside Beauty

To our engineers this flora is merely weeds and brush; they ply it with grader and mower. Through processes of plant succession predictable by any botanist, the prairie garden becomes a refuge for quack grass. After the garden is gone, the highway deparment employs landscapers to dot the quack with elms, and with artistic clumps of Scotch pine, Japanese barberry, and Spiraea. Conservation committees en route to some important convention, whiz by and applaud this zeal for roadside beauty.
Aldo Leopold, 1949

Not until the Highway Beautification Act of 1965 were highway departments legally responsible to beautify rights-of-way. Until then, roadside development had few resources to spare. From 1965 more landscape architects were hired, and more of what Leopold witnessed continued. Ironically, the force behind the Beautification Act, Mrs. Lyndon Johnson, spoke of natural beauty, much like Leopold.

To me, in sum, beautification means our total concern for the physical and human quality we pass on to our children and the future. Further, she wrote, we are the road-buildingest nation on earth....therein lies both the glory and the burden of road-building. In disturbing so much of the turf of this beautiful country, incur a special debt not only in terms of land use but also in an aesthetic sense. We are obligated to leave the country looking as good if not better than we found it.
Mrs. Johnson, 1993

That natural beauty or our natural heritage is threatened, in part, because of the misinterpretation of the word, "beauty". Many nonnative ornamental forbs, grasses, shrubs and trees have been planted in rural roadsides, where they have no relationship to the natural beauty around them. They appear, instead, to relate to a traditional European view of beauty, not America's. In addition, not only do they displace our natural heritage in appearance, but the invasive species among them outcompete native plants and displace valued endangered plants. When planting in our natural environment, the consequences to the future should be considered in planting decisions, a part of the burden of road-building.

Along our railroad rights-of-way one meets the last stand of these prairie flowers. What a wealth we would have if our prairie roads could be lined with this rich carpet of colors, miles of flowers reflecting their colors in the sky above, or millions of sungods in the strong prairie breeze nodding their heads to the sun that had given them their golden hue.
Jens Jensen, 1939

What is really desired, however is attractive and useful roadsides which can be obtained by preserving or creating a natural or an approach to a natural condition in keeping with the adjacent or surrounding country.
J.M. Bennett, 1939

Protecting the utility, beauty, and intrinsic value of our roadside biota remains our responsibility. It's the only management decision that makes sense.
J. Baird Callicot, and Gary K. Lore, 1999

A Vision for Roadsides of the 21st Century

Based on Aldo Leopold's land ethic and Lady Bird Johnson's attention to natural beauty, we now have the opportunity to define a vision for the future of roadsides. It is important to say that we have great pride in our many roadside managers and crews, who daily do the right thing as defined by law, budgets, and public opinion. We should build on their common sense in the 21st Century, as well as lessons learned from the past. Restoring and protecting each State's natural heritage, beauty, and utility will be the underlying goal.

> *Wherever I go in America, I like it when the land speaks its own language in its own regional accent.*
> Ladybird Johnson, 1993.

Mrs. Johnson understands the importance of each region's unique identity and its natural heritage. That natural heritage is different in each State and different in each region of that State. Natural heritage is the combination of all the elements in the environment around us, a community of plants, animals and people living together.

> *That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics.*
> Aldo Leopold, 1948.

Thus, a renewed land ethic for roadside managers will be defined as care and respect for the natural environment within and adjacent to highway corridors. Those highway corridors will serve as buffers to environmental insults, transitions to natural and man-made environments, havens for endangered species and communities, refuges of biodiversity, and preserves of natural beauty. This roadside ethic will be a source of pride within the workforce and throughout neighboring communities.

This vision for the future draws further on the past. This vision yearns for a time when weekend drives are once again a source of recreation and reconnection with nature, a family affair/reunion where time slows down, we talk with one another, we stop at a rest area for a break or even a packed picnic lunch. More and more highway rest areas will offer walking trails and views of the surrounding countryside to reinforce the calm and peace that humans continue to seek.

In the future, Leopold and Johnson's caring will be respected and reflected on America's roadsides, our opportunities for conservation.

Glossary

Agricultural approach: known vegetation management solutions copied from farming experience. An effort to control nature.

Community: a grouping of organisms which grow together in the same general place and have mutual interactions. Relatively undisturbed plant communities are used as benchmarks for restoration, revegetation, rehabilitation and mitigation projects.

Ecological approach: known vegetation management learned from scientific research. A holistic way of working with nature.

Ecotype: a strain or race of a species which is differently adapted to the environment than other populations of the same species.

Erosion Control: the work necessary to stabilize soils/slopes during a construction project or anytime soils are disturbed. Vegetation is one of those stabilizers.

Executive Memorandum (EM): A strong recommendation of policy from the White House. In 1994, the EM on beneficial landscaping called for increased use of native plants.

Executive Order(EO): an 1999 order signed by the President that has the weight of law. In 1999, EO13112 was directed at invasive species control, and restoration of native plants as part of continued vegetation management.

Forb: a specialized term for any non-grassy herbaceous plants. Broad-leaved herbaceous plants.

Guidance: Federal suggestions as to how EO, EM, or Acts of Congress should be implemented.

Hardiness: a horticultural term that indicates a plants tolerance to site conditions, especially cold temperatures.

Integrated Roadside Vegetation Management (IRVM): controlling plants with a combination of tools, including mowing and spraying, that results in a healthy plant community, less maintenance, reduced costs, and possibly improved esthetics.

Invasive Plants*: plants that have been introduced into an environment in which they did not evolve and thus usually have no natural enemies to limit their reproduction and spread. These plants have been called a variety of terms over time: exotics, aliens, weeds, non-natives, pest plants, biological pollution, non-indigenous harmful species, and more. Many are found on noxious weed lists. Some native plants can also be invasive.

Kuchler: A.W. Kuchler's Potential Natural Vegetation of the United States was completed at the University of Kansas in 1966 and revised in 1985. The Kuchler map gives a quick glance to presettlement vegetation and a plant community descriptions, a clue to plant associations.

MOU (memorandum of understanding): is an interagency written agreement.

Mitigation: restoration, recreation, reclamation, revegetation of wetland vegetation and function in exchange for unavoidable wetland or other impacts.

Native wildflowers: Forbs and grasses that were known to exist in any given region at time of European settlement.

Noxious weeds: plants determined by State and Federal agriculture departments to be

harmful to human health, detrimental to agriculture, and/or upset the balance of natural areas. Plants that are native, like poison ivy, can be found on these lists. By law, once listed, noxious weeds must be controlled by landowners. Not all States have these lists.

Pioneer species: a plant found in early stages of succession, usually able to grow on bare soils in full sunlight under variable conditions of soil moisture and soil nutrients.

Remnant: a fragment of an original plant community remaining after the destruction of the bulk of the community by agriculture or development. (or other disturbances, natural or manmade activities)

Reclamation: replanting of highly disturbed soils after original cover has been removed.

Re creation: planting a plant community to a site on which it did not historically exist.

Rehabilitation: repairing an existing community by careful removal of invasives and planting natives only if they do not exist in the seed bank of the site.

Restoration: planting a plant community to a disturbed site where it originally existed.

Revegetation: replanting of soils after original cover has been removed.

Roadside: the green and growing area from the edge of pavement to the right-of-way fence. This right-of-way has a variety of uses, yet is expected to look good, serve as a recovery area, allow water runoff, accommodate signing and utilities, add a visually-pleasing drive, provide habitat for birds and small mammals, protect natural heritage, store snow during winter, and more.

Shrub-carr: a shrub community or intermediate stage between a wet grassland and wet forest type.

Site: a place or location.

Succession: change over time and space.

Vegetation: the total of the plant communities of a region.

Vegetation Management: controlling plants, primarily for safety reasons (visibility and obstacles) especially encroachment of trees and shrubs), traditionally through fence to fence mowing and blanket spraying. ……..

Weeds: Common term for invasive plants controlled over time by agricultural practices.

References: BOOKS

NATIVE PLANTS

Diekelmann, J. and R. Schuster, 1982. *Natural Landscaping.* McGraw-Hill, NY. In reprint.

Harper-Lore, Bonnie and Maggie Wilson, Editors, 2000. *Use of Native Plants on Roadsides, A Handbook.* Island Press, Covelo, CA.

Hightshoe, Gary L. 1987. *Native trees, Shrubs, and Vines for Urban and Rural America.* Van Nostrand Reinhold Company, NY.

Wilson, William H.W., 1984. *Landscaping with Wildflowers & Native Plants.* Chevron Chemical Company, San Francisco.

INVASIVE PLANTS

Westbrooks, R. 1998, *Invasive Plants, Changing the Landscape of America,* a handbook. Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW), Washington D.C.

Randall, John M. and Janet Marinelli, Editors, 1996. *Invasive Plants, Weeds of the Global Garden.* Brooklyn Botanic Garden, NY.

Tu, M., Hurd, C. and J.M. Randall, 2001. *Weed Control Methods Handbook.* The Nature Conservancy, www.tncweeds.ucdavis.edu.

Miller, James H., 2003. *Nonnative Invasive Plants of Southern Forests, A Field Guide for Identification and Control.* Forest Service Southern Research Station, Ashville, North Carolina.

NRCS, 2003. *Noxious Weed Treatment Quick Reference* (a method matrix for Montana that applies to most States). Statewide Noxious Weed Awareness and Education Campaign, Bozeman.

Tellman, Barbara, 2002. *Weeds Across Borders, Proceedings of a North American Conference.* Arizona-Sonora Desert Museum, Tucson

RESTORATION AND MANAGEMENT

Denklau, Amy, Editor, ongoing. *Land and Water.* Fort Dodge, IA

Egan, Dave, Editor, ongoing. *Ecological Restoration.* University of Wisconsin Arboretum, Madison.

Williams, E. Charles, Editor, ongoing. *Natural Areas Journal.* Bend, OR.

Meffe, Gary K. Editor, ongoing. *Conservation Biology,* the Journal of the Society for Conservation Biology. Blackwell Science, Inc. Boston.

NRVMA, 1997. *How to Develop and Implement an Integrated Roadside Vegetation Management Plan.* National Roadside Vegetation Management Association, Newark.

Packard, Stephen and Cornelia F. Mutel, 1997. *The Tallgrass Restoration Handbook, For Prairies, Savnnas, and Woodlands.* Island Press, Covelo, CA.

Collins, Beryl Robichaud, and Karl H. Anderson, 1994. *Plant Communities of New Jersey, A Study in Landscape Diversity.* Rutgers University Press, New Brunswick.

Curtis, John T., 1959. *The Vegetation of Wisconsin.* University of Wisconsin Press, Madison.

Daubenmire, Rexford, 1968. *Plant Communities, A Textbook of Plant Synecology.* Harper & Row, Publishers, New York.

NRCS and Ducks Unlimited Canada, 1998. *Vegetating with Native Grasses in Northeastern North America.* United States Department of Agriculture, Washington D.C.

Taylor, Walter Kingsley, 1998. *Florida Wildflowers in Their Natural Communities.* The University of Florida Press, Gainsville.

Vickery, Peter D. and Peter W. Dunwiddie, Eds., 1997. *Grasslands of Northeastern North America, Ecology and Conservation of Native and Agricultural Landscapes.* Massachusetts Audubon Society, Lincoln, Massachusetts.

References: WEBSITES

NATIVE PLANTS

natareas.org is the website of the **Natural Areas Association,** an international nonprofit with a mission to preserve natural diversity… lots of land management information.

natureserve.org is the website of **Nature Serve Explorer,** an online encyclopedia for 50,000 plants and ecological communities of the United States and Canada. With the common or scientific name of a plant, you can learn its life history, distribution map, and more.

mobot.org is the long-recognized home of the **Center for Plant Conservation**. Packed with information for both homeowners and land managers, the site offers a State by State Directory of conservation contacts.

nanps.org began in 1984 due to the vision of the Canadian Wildlfower Society. The **North American Plant Society** serves to connect plant societies with the purpose of preservation and education. State and provincial native plant societies are listed here.

nps.gov/plants is home of the federal interagency **Plant Conservation Alliance** that began in 1994 with the purpose of sharing information and resources on behalf of native plants.

wildflower.org is the website of the **Lady Bird Johnson Wildflower Center** with the mission to educate about the environmental necessity, economic value, and natural beauty of wildflowers and native plants across America.

INVASIVE PLANTS

aphis.usda.gov/weeds addresses the role of **Agriculture Plant Health Inspection System** (APHIS) in halting the entry of invasive species.

blm.gov/weeds shares management information and especially addresses how to prevent the spread of weeds…**Bureau of Land Management** (BLM).

fhwa.DOT/roadsides is the **Federal Highway Administration** (FHWA) website which attempts to connect private and public sector supporters of greener roadsides.

ficmnew.gov is home of the **Federal Interagency Committee for the Management of Noxious and Exotic Weeds** (FICMNEW), an interagency partnership to pull together all stake holders since 1994.

fs.fed.us/vegtools serves up vegetation management tools from the **U.S. Forest Service**.

invasives.fws.gov is home to the Invasive Species Program of **U.S. Fish and Wildlife Service**.

invasivespecies.gov is the gateway to the federal effort based on EO131112: **National Invasive Species Council** (NISC) There you can find a copy of the national invasive mgt. plan and related information.

invasive plants.net contains Cornell's program in **Biological Control** of non-indigenous plants.

nps.gov/plants/aliens is the **Weeds Gone Wild** site of the Plant Conservation Alliance.

plants.usda.gov is home to the **Natural Resources Conservation Service'** view of federal andstate weed law, **Invasive Plants** including the federal noxious weed list as well as the noxious weed laws of most States.

pwrc.usgs.gov.WLI is home to the NRCS/USDA-sponsored site of the **Wetland Science Institute**. There invasive plants that threaten wetland restoration/mitigation are explored.

refugenet.org is filled with conservation resources and regional invasive species information thanks to the USFWS **National Wildlife Refuge** effort.

TNC.weeds@ucdavis.edu TNC's **Wildland Invasive Species Program** offers decision-makers years of land management experience from The Nature Conservancy (TNC) regarding problem plants, control methods, a power point presentation you can use, a press release template, and ways to utilize volunteers. Their on-going listserve keeps you informed on practical and policy matters..

USGS.gov/invasive, home to the **United States Geological Survey** invasive formation.

RESTORATION AND MANAGEMENT

SER.org is home to the **Society for Ecological Restoration** whose collective expertise in restoration qualifies them as a go-to website of both scientific information as well as how-tos. Note the restoration primer.

conservationbiology.org is home to the **Society of Conservation Biology**, a useful Journal.

tnc.org is home to **The NatureConservancy**, for land mangement information.

Mobot.org/invasives offers a copy of the 2001 St. Louis Declaration on Invasive Plant Species. Linking Ecology and Horticulture to Prevent Plant Invasions from the **Missouri Botanic Gardens**.

Esa.sdsc.edu/invas3 constains fact sheets from the **Ecological Society of America**.

References: REGIONAL PLANT CENTERS

aquat1.ifas.ufl.edu is the **Center for Aquatic and Invasive Plants** since 1979. The site contains images and information for 383 native and non-native species found in Florida plus.

blm.gov.education/high_plains/weed takes you to **The High Plains** weed site.

blm.gov/weeds focuses on the spread of weeds in **Western Wildlands**.

npwrc.usgs.gov targets weeds of the **Prairie Region**. It includes the Hiebert ranking assessment.

invader.dbs.umt.edu is the website of the **INVADERS Database System** from the University of Montana contains the INVADERS Database System provided by the Agricultural research Service (ARS), USDA. The site includes U.S. and Canadian noxious weed lists.

newfs.org the **New England Wild Flower Society** addresses invasive plants in New England.

uni.edu/irvm is the **Integrated Roadside Vegetation Management** homepage from the newnational center at the University of Northern Iowa.

usgs.nau.edu/SWEPIC/swemp serves the southwest via the **Southwest Exotic Plant Information Clearinghouse**. This site is filled with practical information for this region.

weedcenter.org is home to an in-depth western weed clearinghouse of information. The information comes to us from the **Center for Invasive Plant Management** in Bozeman, Montana

wsweedscience.org is home to the **Western Society of Weed Science,** made up of seed science professionals in the western U.S. and Canada.

References: INVASIVE PLANT COUNCILS

caleppc.org offers California's wildland plant threats as part of the work of the **California Exotic Pest Plant Council** (CALEPPC).

cwma.org is the website of the **Colorado Weed Management Association** (CWMA).

cipwg.org serves the **Connecticut Invasive Plant Working Group** (CIPWG). Developed State list. Among their links, Native Alternatives for Invasive Ornamental Plant Species.

fleppc.org is home to the **Florida Exotic Pest Plant Council.** The site is information-packed.

gaeppc.org is home to the **Georgia Exotic Pest Plant Council.**

hear.org is home to **Hawaii's** invasive plant effort, the Big Island Invasive Species Committee.

ipcnys.org is the domain of the **Invasive Plant Council of New York State.** They include a list of concern along with alternative plants to use.

mdinvasivesp.org is the new site of **Maryland's Invasive Species Council.**

ma-eppc.org addresses the exotic plants that threaten the **Mid-Atlantic** region's economy, environment and human health. The site appears to be the only one of its kind in Spanish.

forestry.msu.edu/mipc or MIPC.org serves the **Michigan Invasive Plant Council** that is developing an interim short list of invasives of concern in their State.

mobotgradstudents.org will lead you to the **Missouri Exotic Pest Plant Council.**

eeb.uconn.edu/ipane. Since 1999 the **New England Invasive Plant Group** has focused on an Invasive Plant Atlas of New England (IPANE) and an early warning system for their region.

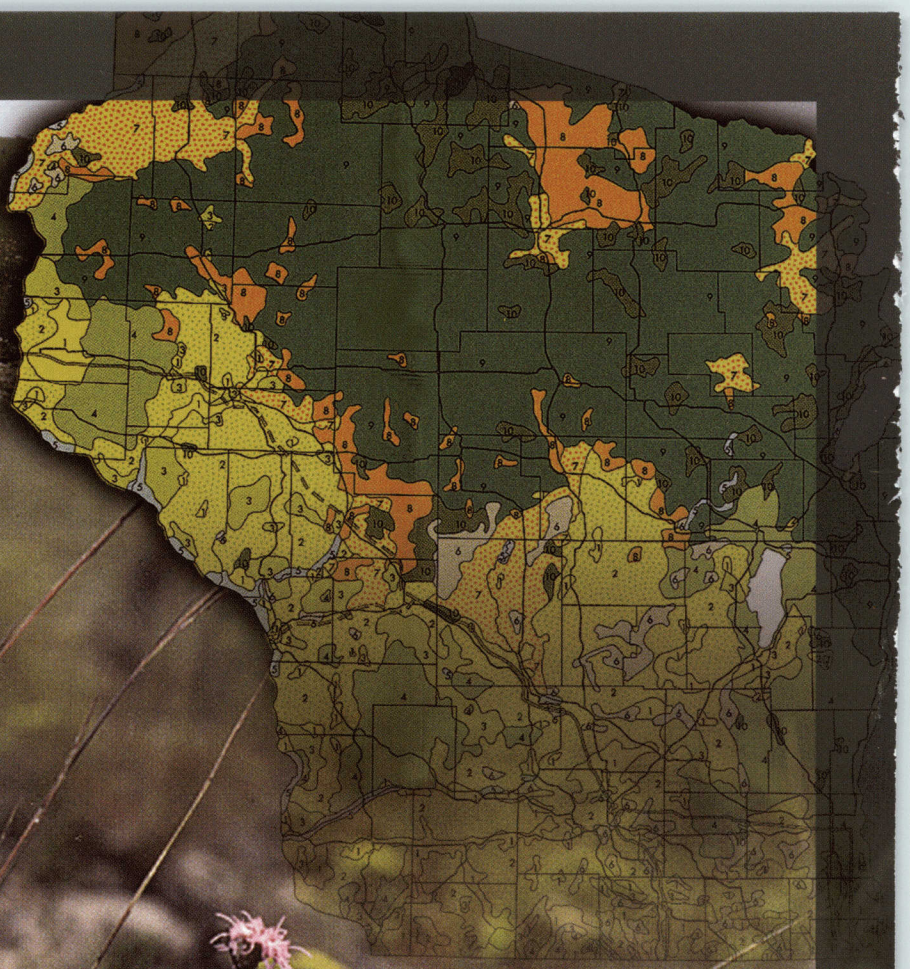
NAWMA. Org is the website of the **North American Weed Managers Association** which Unites forces on the ground with best management practices and partnerships.

se-eppc.org includes seven southeast States in the **Southeast Exotic Pest Plant Council.** This site aims to raise public awareness and facilitate the exchange of information concerning invasives management. It provides a compilation of invasives for 13 Southern States and includes the South Carolina Council..

usgs.nau.edu describes the **Southwest Exotic Plant Council** includes their mapping program.

uwex.edu/ces/ipaw is home to the **Invasive Plants Association of Wisconsin** (IPAW) since 2001. Promotes stewardship of natural resources through public awareness and more.

wnps.org is home to the **Pacific Northwest Exotic Pest Plant Council.**



U.S. Department of Transportation
Federal Highway Administration
Office of Natural and Human Environment
400 Seventh Street SW, Rm. 3240
Washington D.C.

Publication No. FHWA-EP-03-005
HEPN-30